

CLAIMS

1. A powder filling nozzle used for filling up a container with a powder mixed with a gas and in a fluidized state, comprising:

a tubular body having an opening for discharging the powder in the fluidized state into the container; and

a gas separating unit disposed near the opening of the tubular body and allowing the gas delivered together with the powder in the tubular body to pass through the gas separating unit but not allowing the powder to pass through the gas separating unit,

wherein the gas separating unit serves to set the opening in a plugged state by the powder separated from the gas, so that the delivery of the powder from the tubular body into the container is stopped.

2. The powder filling nozzle of claim 1 wherein the tubular body has a double pipe structure including a first tubular body and a second tubular body, the first tubular body being inserted into the second tubular body so that a gap between the two tubular bodies is formed as a gas delivery path, both ends of the second tubular body being fixed to the first tubular body so as to close the gap, the first tubular body serving as a delivery path which discharges the powder in

the fluidized state fed from one opening of the first tubular body into the container through the other opening of the first tubular body, the gas separating unit being made of a filter part which does not pass the powder therethrough but allows
5 the gas to pass therethrough, the second tubular body having a gas exhausting port connected with an external gas suction unit, and the second tubular body having a function of discharging the gas, passing through the filter part and being attracted to the first tubular body by operation of the
10 external gas suction unit, from the gas exhausting port through the gas delivery path.

3. The powder filling nozzle of claim 2 wherein the tubular body has a triple pipe structure including a third
15 tubular body in addition to the first and second tubular bodies, the third tubular body having an inner diameter larger than an outer diameter of the second tubular body, the second tubular body being inserted into the third tubular body so that a gap between the second and third tubular bodies is
20 formed as a second gas delivery path, both ends of the third tubular body being fixed to the second tubular body so as to close the gap, the third tubular body having a gas exhausting port connected with a second external gas suction unit, and the third tubular body having a function of attracting through
25 the filter part the gas, existing in the powder discharged

into the container, by operation of the second gas suction unit, and having a function of discharging the gas, passing through the second delivery path between the second tubular body and the third tubular body, from the second gas
5 exhausting port.

4. The powder filling nozzle of claim 1 wherein the opening of the tubular body is constituted by a through hole which is formed in the first tubular body, and the gas
10 separating unit is constituted by a filter part which is provided on a circumference of the first tubular body so that the through hole is covered with the filter part.

5. The powder filling nozzle of claim 2 wherein the
15 first tubular body has a lamination structure in which a tubular member of a filter material and a tubular member of a non-filter material are bonded, and the tubular member of the filter material serves as the filter part.

20 6. The powder filling nozzle of claim 4 wherein the filter part is made of a twill-weave filter material.

7. The powder filling nozzle of claim 5 wherein the filter part is constituted by a laminated member made of two
25 or more filter materials with different meshes.

8. The powder filling nozzle of claim 7 wherein the laminated member has a fine-mesh filter material at an inner core portion of the first tubular body.

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9. The powder filling nozzle of claim 2 wherein a width of the filter part is larger than 0.3 times an inner diameter of the opening of the first tubular body.

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10. A powder filling device including a hermitically sealed powder fluidization unit and a powder filling nozzle, the powder filling device filling a powder, mixed with a gas and changed to a fluidized state by the powder fluidization unit, into a container through a delivery path by using the powder filling nozzle, the powder filling nozzle comprising:

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a tubular body having an opening for discharging the powder in the fluidized state into the container; and

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a gas separating unit disposed near the opening of the tubular body and allowing the gas delivered together with the powder in the tubular body to pass through the gas separating unit but not allowing the powder to pass through the gas separating unit,

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wherein the gas separating unit serves to set the opening in a plugged state by the powder separated from the

gas, so that the delivery of the powder from the tubular body into the container is stopped.

11. The powder filling device of claim 10 wherein
5 the powder filling nozzle has a double pipe structure, one end of the powder filling nozzle is connected to the powder fluidization unit via a powder transport pipe serving as the delivery path, and the powder filling device comprises a gas suction nozzle for attracting and discharging the gas existing
10 in the powder discharged into the container.

12. The powder filling device of claim 10 wherein the powder filling device works with an electric power obtained from at least one of natural power sources including
15 a sunlight energy and a wind power energy and used as a source of power.

13. The powder filling device of claim 11 wherein the powder filling device comprises a first gas suction unit
20 connected with a first gas exhausting port of a second tubular body which constitutes the powder filling nozzle, and a second gas suction unit connected with the gas suction nozzle.

14. The powder filling device of claim 10 wherein
25 the powder filling nozzle has a triple pipe structure, and one

end of the powder filling nozzle is connected to the powder fluidization unit via a powder transport pipe serving as the delivery path.

5 15. The powder filling device of claim 14 wherein the powder filling device comprises a first gas suction unit connected with a first gas exhausting port of a second tubular body which constitutes the powder filling nozzle, and a second gas suction unit connected with a second gas exhausting port
10 of a third tubular body which constitutes the powder filling nozzle.

 16. The powder filling device of claim 10 wherein a lid member which is made of a ventilation porous material and
15 includes a hole for inserting the powder filling nozzle therein is fitted into an opening of the container in a state in which the powder filling nozzle is inserted in the hole of the lid member.

20 17. The powder filling device of claim 10 wherein the powder fluidization unit has an introductory gas control valve which is capable of adjusting a flow velocity of introductory gas, and a delivery powder flow velocity control valve which is capable of adjusting a flow velocity of the
25 powder in the fluidized state within the delivery path.

18. The powder filling device of claim 10 wherein the powder fluidization unit has a gas introducing unit for changing the powder into the fluidized state, and the gas
5 introducing unit is a pressure vessel in which the gas is contained in a manner that the gas can be fed to the powder fluidization unit.

19. The powder filling device of claim 10 wherein
10 the powder fluidization unit has a gas introducing unit for changing the powder into the fluidized state, and the gas introducing unit is a gas delivery pump with a check valve.

20. The powder filling device of claim 10 wherein
15 the powder fluidization unit has a gas introducing unit for changing the powder into the fluidized state, and a gas dispensing unit for introducing the gas into the powder fluidization unit uniformly.

20 21. The powder filling device of claim 10 wherein the powder is a toner for developing an electrostatic latent image.

22. A powder filling method for filling up a
25 container with a powder in a fluidized state by using a powder

filling device which includes a hermitically sealed powder fluidization unit and a powder filling nozzle, the powder filling nozzle comprising a tubular body having an opening for discharging the powder in the fluidized state into the
5 container, and a gas separating unit disposed near the opening of the tubular body and allowing a gas delivered together with the powder in the tubular body to pass through the gas separating unit but not allowing the powder to pass through the gas separating unit, the powder filling method comprising
10 the steps of:

mixing the powder contained in the powder fluidization unit with the gas to obtain the powder in the fluidized state;

delivering the powder in the fluidized state from
15 the fluid fluidization unit into the powder filling nozzle via a delivery path so that the powder is discharged into the container from the powder filling nozzle; and

setting the opening of the tubular body in a plugged state by the powder separated from the gas by the gas
20 separating unit so that the delivery of the powder from the tubular body to the container is stopped.

23. The powder filling method of claim 22 wherein a bulk density of the powder at a time of delivery is in a range
25 of 0.1 to 0.2.

24. The powder filling method of claim 22 wherein a lid member in which the nozzle is inserted and held is fitted in the container, and the powder is discharged through the
5 nozzle into the container.

25. The powder filling method of claim 22 wherein the fluidization of the powder into the fluidized state is performed by introducing additional gas into the powder
10 fluidization unit.

26. The powder filling method of claim 22 wherein the fluidization of the powder with the gas is performed by vibrating the powder fluidization unit.
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27. The powder filling method of claim 22 wherein the delivery of the powder from the powder fluidization unit to the nozzle is performed by increasing a pressure within the powder fluidization unit.
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28. The powder filling method of claim 22 wherein the delivery of the powder from the powder fluidization unit to the nozzle is performed by applying an external pressure to the powder fluidization unit and decreasing an internal volume
25 of the powder fluidization unit.

29. The powder filling method of claim 22 wherein the delivery of the powder in the fluidized state by the powder fluidization unit is stopped by operation of a first
5 gas suction unit.

30. The powder filling method of claim 22 wherein a bulk density of the powder at a time of stopping is in a range of 0.4 to 0.5.

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31. The powder filling method of claim 22 wherein an amount of discharge of the powder in the fluidized state is controlled by regulation of a suction pressure by operation of the first gas suction unit.

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32. The powder filling method of claim 29 wherein a gas suction pressure of the first gas suction unit is in a range of -10kPa to -60kPa.

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33. The powder filling method of claim 22 wherein an amount of discharge of the powder in the fluidized state is controlled by regulation of opening and closing of an introductory gas control valve or a discharge powder flow velocity control valve of the powder fluidization unit.

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34. The powder filling method of claim 22 wherein the nozzle has a double pipe structure, a gas suction nozzle used together with the nozzle is installed so that a leading edge of the gas suction nozzle is surrounded by the powder in the container, and the gas existing in the powder discharged into the container is discharged by operation of a second gas suction unit.

35. The powder filling method of claim 22 wherein the nozzle has a triple pipe structure, the nozzle is installed so that the powder in the container surrounds a leading edge of the nozzle, and the gas existing in the powder discharged into the container is discharged by operation of a second gas suction unit.

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36. The powder filling method of claim 34 wherein a gas suction pressure of the second gas suction unit is in a range of -10kPa to -60kPa.

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37. The powder filling method of claim 29 wherein, when the container is filled up with a given amount of the powder, the delivery of the powder is stopped and the lid member is removed from the container.

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38. The power filling method of claim 22 wherein

the powder is a toner for developing an electrostatic latent image.

39. A container with which the powder is filled
5 according to the powder filling method of claim 22.

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